Historic, archived document

Do not assume content reflects current
scientific knowledge, policies, or practices.

U. S. FOREST SERVICE
Pacific North West Research Note
FOREST AND RANGE EXPERIMENT STATION · U S DEPARTMENT OF AGRICULTURE · PORTLAND, OREGON

PNW-13 May 1964

A COMPARISON OF HIGH-LEAD YARDING PRODUCTION RATES IN WINDTHROWN AND STANDING TIMBER

by Virgil W. Binkley

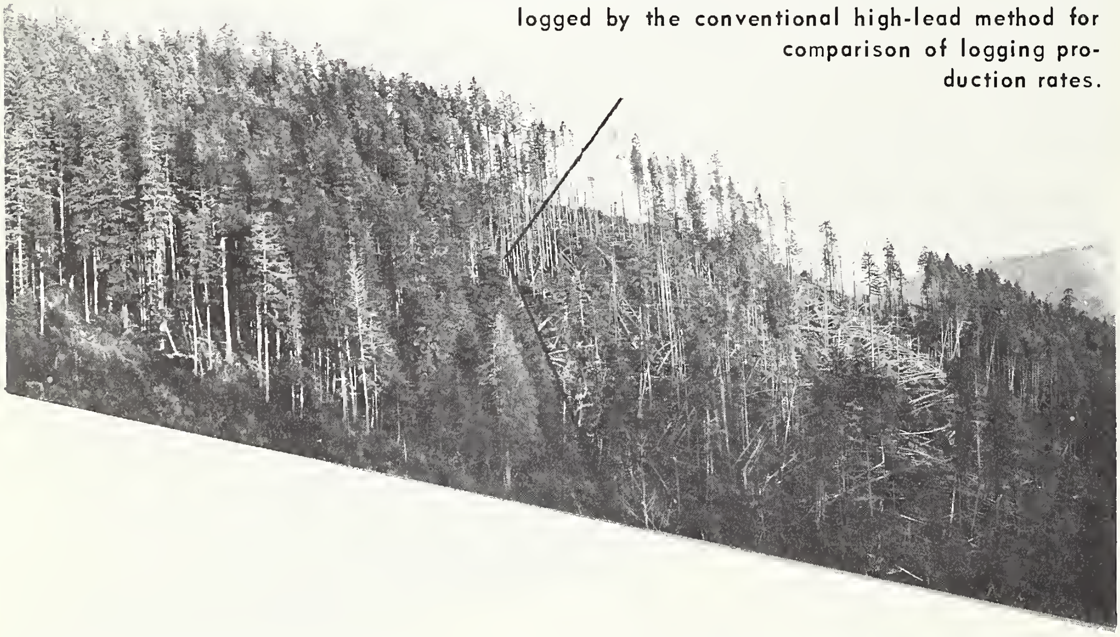
A severe windstorm struck western Oregon and Washington on October 12, 1962, and blew down or damaged an estimated 17 billion board feet of timber along a 400-mile path.[1] Forest-land owners and public forest agencies immediately began a major salvage program, aimed at harvesting as much as possible of this blowdown before May 1964 to prevent a potential insect outbreak of bark beetles and to accomplish salvage before decay. This provided an opportunity to study production rates (output per man-hour and output per machine-hour) of felling and bucking and yarding in windthrown timber as compared with corresponding rates in standing timber. Results of this study should be helpful in determining production rates elsewhere, during the present salvage program and in the future.

This study was conducted in the Fall Creek drainage of the Cascade Head Experimental Forest, near Otis, Oreg., where approximately 1.5 million board feet of blowdown occurred. The predominantly 115-year-old windthrown stand in this drainage was adjacent to an intact stand of nearly the same age class, stocking, slope gradient, and aspect. Purpose of the study was to compare conventional high-lead yarding production rates in the two stands.

PROCEDURE

Two adjacent high-lead settings were laid out, with one in the standing green timber area and the other in the blowdown area (figs. 1 and 2). Volumes logged, machine-hours, and man-hours were recorded separately for each area. Comparative felling and bucking production rates were recorded over each complete area.

Figure 1.--Blowdown study area at Cascade Head Experimental Forest before harvest. In this study, the standing green timber area indicated at left and blowdown area at right were both logged by the conventional high-lead method for comparison of logging production rates.



---

[1] Revised estimate by Northwest Pest Action Council. See also: Orr, P. W. Windthrown timber survey in the Pacific Northwest, 1962. U.S. Forest Serv. Pacific Northwest Region, 22 pp., illus. 1963.

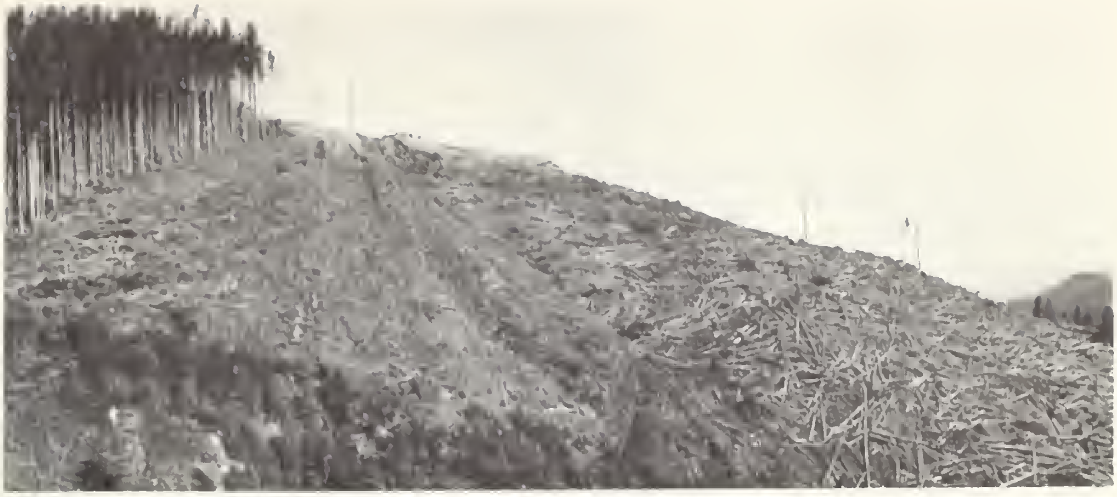


Figure 2.--Same view as figure 1, with high-lead yarding completed on standing green timber study area (left) and trees felled on the blowdown area (right). Note the tree-length logs in the lower right of the photo. High-lead spar used to yard the blowdown area was not rigged when this photo was taken.

Data on log count, machine-hours, and man-hours were recorded by the logging crews for each complete area during actual yarding operations. Log volume was obtained at a highway scaling station in the usual manner by the Columbia River Log Scaling and Grading Bureau.

The same felling and bucking crew was used in both areas. Felling and bucking in the standing timber area was carried out in the conventional manner, felling trees and then bucking them into suitable log lengths. For safety reasons, however, bucking in the blowdown area consisted of bucking only at stump and top or in multiple log lengths.

High-lead yarding was accomplished in a normal manner on the standing green timber area. Yarding on the blowdown area was by the same high-lead yarder and crew, with the addition of a high-lead swing to the landing used to yard the standing timber area. This was a hot swing and is considered to have had no effect on the production because yarding was not held up by the swing operation (see fig. 3). Logs were yarded in tree length or multiple log lengths from the blowdown area, and were bucked into logs at the final landing by the chaser and second loader between turns and in slack periods prior to loading.

Yarding production data were collected over the entire standing green timber area, but over only that segment of the blowdown area having terrain features similar to that of the standing green timber area (fig 3).

A 130-horsepower, triple-drum yarding machine and an eight-man high-lead crew were used to yard both areas. Yarding crew consisted of a foreman (hooker), yarder engineer, chaser (unhooker at the landing), signalman, rigging slinger (foreman of rigging crew) and three choker setters.

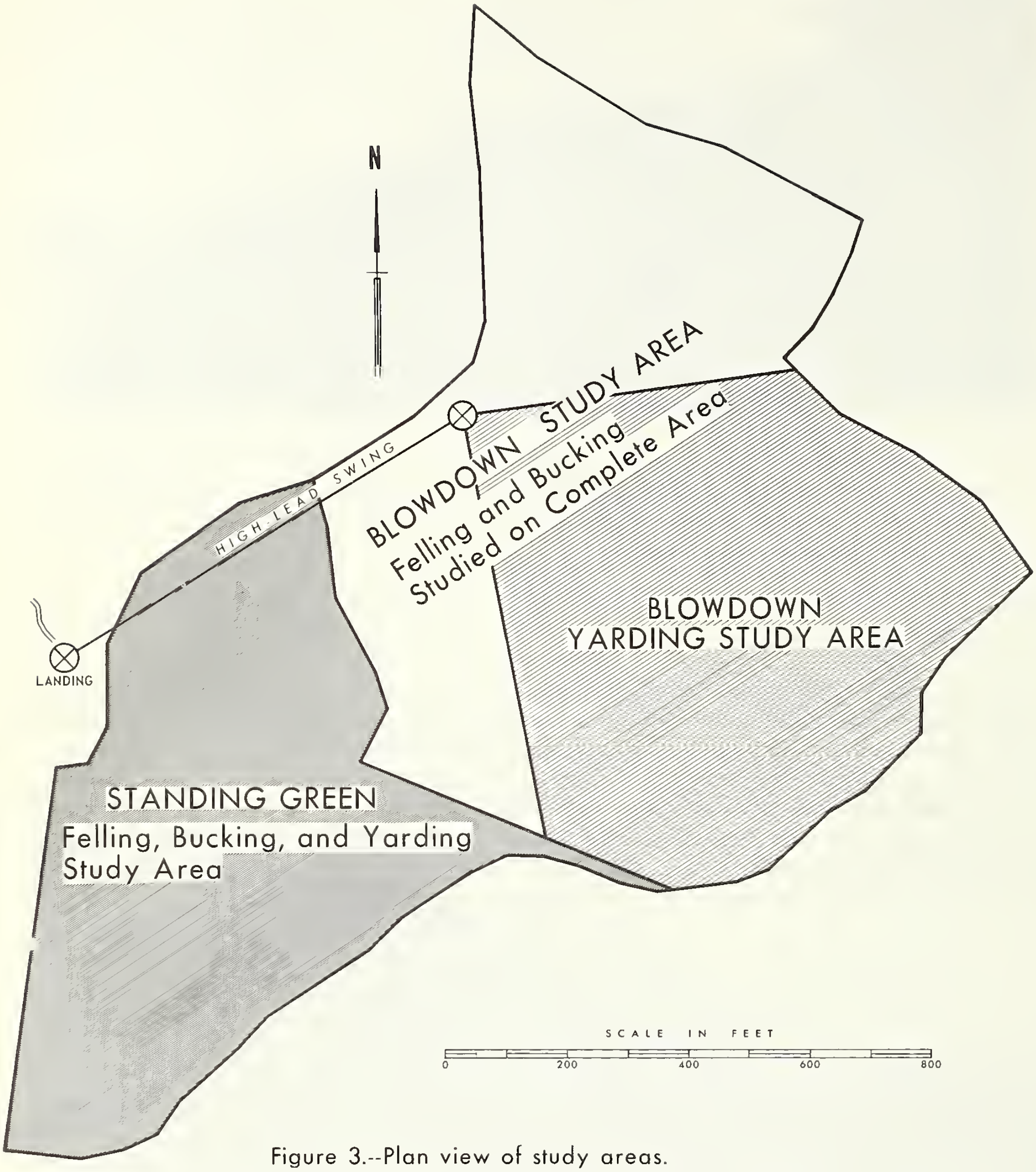


Figure 3.--Plan view of study areas.

RESULTS

Felling and Bucking

Gross log production per man-hour of felling and bucking was 27 percent greater in the blowdown area than in the standing green timber area (table 1). This was due chiefly to the difference in method of bucking as described above. Since the remaining bucking of windthrown timber was carried out at the landing by members of the yarding crew during otherwise slack time, this subsequent bucking time was not included in the calculation of man-hours related to output. This procedure may not be justified, however, under other conditions. Without the available slack time at the final landing, the man-hours for bucking at the landing would have to be included in the total man-hours bucking time, and any delays to yarder, loader, or trucks would have to be accounted for or avoided.

Table 1.--Felling and bucking data from yarding study,

Cascade Head Experimental Forest, 1963

Item		Total standing green timber area	Total blowdown area
Gross log volume	bd. ft.[1]	711,530	1,300,170
Net log volume	bd. ft.[1]	607,000	1,045,670
Total logs	number	3,323	5,132
Average gross log volume	bd. ft.	214	253
Average net log volume	bd. ft.	182	204
Area of setting	acres	11.29	22.08
Gross log volume per acre	bd. ft.	63,023	58,884
Log defect	percent	14.7	19.6
Felling and bucking time	man-hours[2]	528	760
Gross log volume per man-hour	bd. ft.	1,348	1,711
Net log volume per man-hour	bd. ft.	1,150	1,376

[1] Volumes scaled by Columbia River Scaling and Grading Bureau at highway scaling station.

[2] Time was kept by two 2-man felling crews, each man equipped with powersaw.

Defect was greater in logs from the blowdown area than in logs from the standing green timber area. On a gross log basis, log production per man-hour (felling and bucking) was 27 percent greater in the blowdown area.

Yarding

Average external yarding distance, as calculated from the area traverse, was 722 feet for the standing green timber area and 963 feet for the blowdown area. Converting these externals to average yarding distance by the factor 0.707 gives 510 feet for the standing green timber area and 680 feet for the blowdown area.[2]

Gross yarding production per hour on the standing green timber area was 4,906 board feet; on the blowdown area it was 4,067 board feet (table 2). This 21-percent apparent difference in favor of the standing timber area can be made more meaningful by taking into account the difference in average yarding distance and volume per turn in the two areas and their effect on production. Equations for the relationships between production time and yarding distance, slope, volume per turn, and crew size were developed by Tennas, Ruth, and Berntsen from a controlled study using a similar triple-drum yarder on the Cascade Head Experimental Forest in 1954.[3]

Table 2.--High-lead yarding data from yarding study, Cascade Head Experimental Forest, 1963

Item		Total standing green timber area	Blowdown yarding study area[1]
Machine time[2]	hours	145	203.8
Gross log volume	bd. ft.	711,530	829,140
Net log volume	bd. ft.	607,000	684,280
Gross log volume per yarder hour[2] . .	hours	4,906	4,067
Delay time[3]	hours	8.5	28.9
Breakdown time	hours	21.5	11.0
Rig-up and take-down time	hours	200.5	398
Turns	number	1,482	1,166
Logs per turn.	number	2.24	3.14
Gross log volume per turn	bd. ft.	480	711
Turns per hour	number	10.22	5.72
Average yarding distance (slope distance)[4]	feet	510	680
Average slope	percent	48	55

[1] Comparative area as shown in figures 1, 2, and 3.

[2] Excludes breakdown and delay time; includes delays less than 10 minutes.

[3] Delay time kept by logging crew for all delays of 10 minutes or greater.

[4] Average yarding distance is external slope distance times factor of 0.707. Average external slope distance of standing green timber area was 722 feet; average external slope distance of blowdown area was 963 feet.

---

[2] Matthews, Donald M. Cost control in the logging industry. 374 pp., illus. New York: McGraw-Hill Book Co. 1942.

[3] Tennas, M. E., Ruth, Robert H., and Berntsen, Carl M. An analysis of production and costs in high-lead yarding. U.S. Forest Serv. Pac. NW. Forest & Range Expt. Sta. Res. Paper 11, 37 pp., illus. 1955.

These equations are as follows, in which Y = time in hundredths of minutes:

Inhaul $Y_i = 34.76 + 0.167D + 0.000265D^2 + 0.0000485DV + 0.00072VS$

Haulback $Y_{hb} = 16.99 + 0.089D$

Hooking $Y_c = 271.6 + 0.195D - 49.25C$

Unhooking $Y_u = 43.08 + 8.60N$

Calculation of average turn time for the two areas, and corresponding production per hour, is as follows:

		Standing green timber area	Blowdown area
Slope distance (D)	=	510 feet	680 feet
Slope (S)	=	48 percent	55 percent
Turn volume (V)	=	480 board feet	711 board feet
Number of logs (N)	=	2.24 logs	3.14 logs
Choker setters (C)	=	4 men	4 men
Inhaul time (Y_i)	=	2.17 minutes	3.22 minutes
Haulback time (Y_{hb})	=	0.62 minute	0.78 minute
Hooking time (Y_c)	=	1.74 minutes	2.07 minutes
Unhooking time (Y_u)	=	0.62 minute	0.70 minute
Total time per turn		5.15 minutes	6.77 minutes
Turns per hour		11.65 turns	8.86 turns
Output per hour		5,592 board feet	6,299 board feet

Actual yarding output per hour was 4,906 board feet in the standing green timber area, or 12.27 percent less than output calculated by formula (table 3). Had the conditions been the same on the blowdown area, expected output should likewise have been 12.27 percent less than calculated output, or 5,526 board feet (table 3). However, actual production in the blowdown area was only 4,067 board feet, or 26 percent less than would be expected on the same ground without blowdown. The major part of this difference can be attributed to yarding problems associated with the blowdown.

Table 3.--Comparative yarding production, from yarding study, Cascade Head Experimental Forest, 1963

Area	Output per hour		
	Calculated by formula	Actual production	Expected production
	- - - - - - - - -	Board feet	- - - - - - - - -
Standing green timber	5,592	4,906	[1]4,906
Blowdown	6,299	4,067	[2]5,526

[1] The 4,906 board feet per hour is used as a base for expected or the actual production in standing timber by this machine and crew.

[2] Developed using the ratio $\frac{5,592}{6,299} = \frac{4,906}{x}$, or x = 5,526.

CONCLUDING REMARKS

Results of this comparative study indicate that felling and bucking in windthrown timber does not decrease production per man-hour when accomplished in the manner described in this report. In fact, production per man-hour was 27 percent greater in the blowdown area than in a comparable area of standing green timber. This reduction in felling and bucking time can be attributed to the reduced work involved in tree-length bucking. No doubt felling and bucking production in the standing green timber area could have also been increased by tree-length or multiple-log-length bucking.

Yarding output per hour was 26 percent less in the blowdown area, as compared with the output that would be expected for similar conditions without the blowdown. This is largely accounted for by the additional minor delays and hangups in yarding through the additional slash, high stumps, and root wads in the blowdown area (fig. 4).

Under suitable conditions, tree-length yarding in high-lead operations can reduce felling and bucking time, and should be able to increase yarding production by reducing number of pieces handled and by increasing average turn volumes. Bucking on the landing not only occupies slack time, characteristic of high-lead yarding, but also allows for supervised bucking so that the maximum log grade recovery can be realized.

Future studies are needed to develop operational techniques for tree-length yarding in conventional high-lead operations and to determine what increases in production can be anticipated.

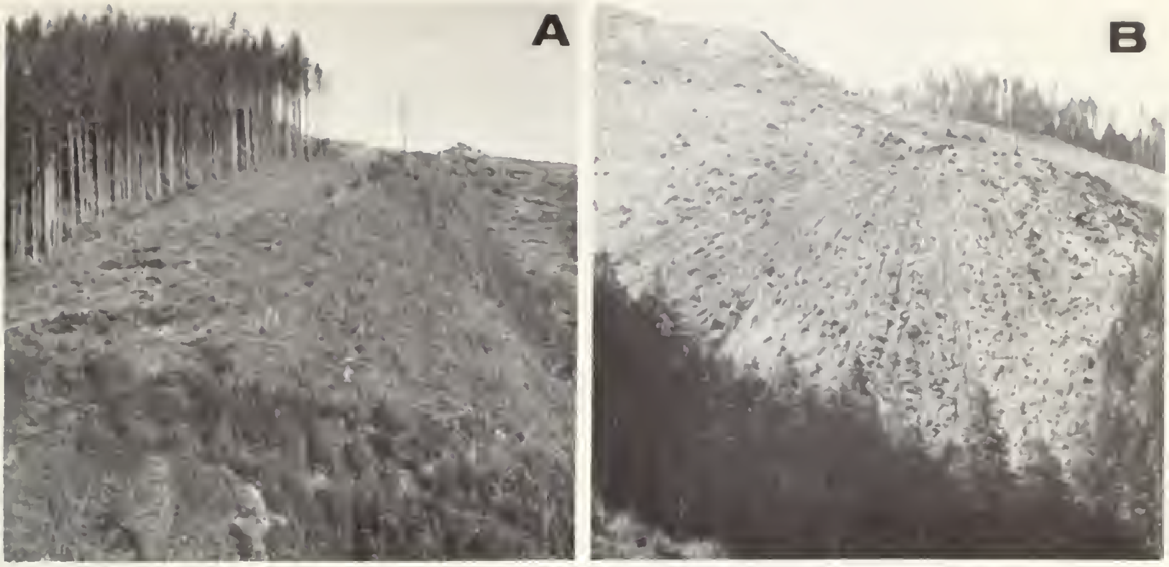


Figure 4.--*A*, Standing green timber area with yarding nearly completed. Timber was felled along the contour resulting in a lay of the logs at 90° to the lead of the spar tree. *B*, Blowdown area with yarding completed. High stumps in this area are caused by the righting of root wads during yarding. Most of the windthrown timber was lying at 90° to the lead of the spar tree.

PSW FOREST & RANGE
EXPERIMENT STATION

JUL [illegible] 1964

STATION LIBRARY COPY